DCS 6000

Technical specifications

Digital Conference System

DCS 6000
External Microphone Control
RS232 protocol

Please refer to 'Revision History' at page 4 for compatibility to releases prior to Release 5.1.

1 List of Contents

1 List of Contents *2*

1.1 Revision history **4**

2 Introduction and document overview *5*

2.1 Restrictions in DCS6000 ..... **5**

2.2 Voting Concepts **5**

2.2.1 Voting session 5

2.2.2 Attendance check 6

2.2.3 Late Attendance 6

2.3 Notation **7**

3 Serial Protocol *8*

3.1 Package format **8**

3.2 CRC Calculation **9**

3.3 Encoding **9**

3.4 Message types **10**

3.4.1 CU reset (CU → external) 10

3.4.2 Change binary Control Mode (external → CU) 10

3.4.3 Send Control Message to CU (external → CU) 10

3.4.4 Receive Control Message from CU (CU → external) 11

3.5 Building a control message – step by step **11**

4 DCS 6000 Messages *12*

4.1 Addresses in the DCS 6000 system **12**

4.2 Group addresses **12**

4.3 Messages from the external unit to the CU **12**

The following sections describe the messages from each message group. 13

4.3.1 Messages in EXTERNAL_CONTROL_GRP 13

4.3.2 Messages in MICROPHONE_CONTROL_GRP 14

4.3.3 MICROPHONE_PRIORITY 17

4.3.4 Messages in EXTERNAL_AUDIO_CONTROL_MU 18

4.3.5 Messages in Voting_CONTROL_GRP 21

4.4 Summary of control messages (External Unit → CU) **24**

4.5 Messages from the CU to the external unit **26**

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Messages in MAIN_GRP 27
4.5.1 Messages in EXTERNAL_CONTROL_GRP 27
4.5.2 Messages in MICROPHONE_STATUS_GRP 28
4.5.3 Messages in EXTERNAL_AUDIO_STATUS_MU 33
4.5.4 Messages in VOTING_STATUS_GRP 35
4.5.5 Messages in UNIT_ATTENDANCE_STATUS_GRP 38
4.5.6 Messages in UNIT_VOTE_STATUS_GRP 40

4.6 Summary of status control messages (CU → External control unit) 41

5 Controlling Microphones 44

5.1 CRC Calculation 44
5.1.1 CU Reset message 44
5.1.2 Entering binary microphone control mode 44

5.2 Registering with the CU 44
5.2.1 Power up of the CU after connecting 45
5.2.2 Power up of the CU before connecting 46

5.3 The Heart Beat process 47

5.4 Retrieving the microphone system status 47

6 Additional detailed example 50

6.1 Example - Registration with the CU 50
6.1.1 Step (1) – Entering Microphone Control Mode 50
6.1.2 Step(2) – Requesting registration in the CU 52
6.1.3 Step(3) – Registration reply from the CU 53

6.2 Example 2 – Turning on the microphone of a delegate. 55

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1.1 Revision history

21-07-2003	A	Initial version of the document.
25-02-2004	B	Corrected a fault in section 3.4.4 Control Job Received (CU → external). Format of the message corrected
17-06-2004	C	Updates and additions to the descriptions.
03-07-2004	D	A section with summary of the control messages and status of control messages has been added. Examples of the code has been added in chapter 6
10-10-2004	E	Commands in section 4.3.2, 4.3.3 and 4.5.3 have been changed as part of the firmware release 5.1. **Applications made for previous releases have to be updated reflecting those changes.** The actual sections are marked with a frame around the text.
14-02-2006	F	Commands for voting control (license option).
08-05-2006	G	Correction to registration, when using voting control.
18-05-2006	H	Addition to voting control (secret voting + 5-button voting)
12-09-2006	I	Addition of message for setting up microphone speak priority. Refer to '4.3.3 MICROPHONE_PRIORITY'

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2 Introduction and document overview

The DCS 6000 system offers the possibility of controlling the microphones from a PC, AMX or other external control unit via a serial connection. This text documents how this feature is used; how external control of the DCS 6000 system is executed.

The protocol used on the cable between the central unit (CU) of the DCS 6000 system and the external control unit is described in general in section 3.

Parts of this protocol encapsulate the protocol used on the DCS 6000 bus and thus enable the CU and the external control unit to communicate as if the latter was a unit on the bus. The parts of the DCS 6000 protocol, which are relevant for controlling the microphones are described in section 4.

Section 5 summarizes and exemplifies how to use the protocol described in sections 3 and 4 to control the microphone application.

Additional detailed examples are shown in section 6.

2.1 Restrictions in DCS6000

The RS232 protocol control described herein provides descriptions for an external control unit to do microphone control, audio settings and voting in the DCS6000 system. Basic functionality is hereby made available, however some restrictions need mentioning:

- The Voting control functionality is protected by a license feature within the CU.
- There is no support for Dual microphone units or units sharing a microphone.
- There is no support for Voting units without microphones.

For voting functionality to become available, the CU must be provided with a CU license key that enables voting and voting control through the RS232 connection.

2.2 Voting Concepts

2.2.1 Voting session

Voting sessions are controlled (setup/opened/closed) from an external control unit.

First, the following voting parameters must be setup from external control:

- Voting Type (3-Button Voting or 5-Button Voting)
- Secret Voting (Open Voting or Secret Voting)

3-Button voting sessions provide the delegates with the option to make a selection among three alternatives: (typically Yes, Abstain and No), whereas 5-button voting sessions offer 5 alternatives (typically ++, +, 0, - and --).

During an Open voting session, the votes are captured by the voting units, and the voting units show to the delegate, which button was pressed. If a voting session is defined as Secret, the voting units still register, when the delegates vote, but they do not reveal, which button was pressed.

A voting session is opened and closed from an external control unit. Only during an open voting session, the delegates are able to cast their votes.

During an Open voting session, the CU informs about votes received from the delegates. And, furthermore, the CU continuously transmits interim results, both when running Open and Secret voting sessions. When the voting session is closed, the CU informs about the final voting result.

The voting result remains in the CU until the next voting session is started, or until the CU is reset. The result is available for an external control unit to read as long as it is valid.

2.2.2 Attendance check

Prior to a voting session, it is often desireable to sustain, how many delegates are actually present. In order to determine the number of delegates present, an Attendance Check is carried out. From an external control unit the CU is commanded to start an attendance check. A single button (the ‘Present’ button) starts flashing on the microphone units, and the delegates can acknowledge their presence by pressing this button.

During an attendance check, the CU informs the external control unit about units, where the delegate has pressed the ‘Present’ button. Furthermore, the CU continuously informs the latest number of present delegates (interim result). When the Attendance check is ended, the CU reports the final attendance check result.

The CU stores the final result until next time an attendance check is started, or until the CU is reset. This result can be read from the CU as long as it is valid.

2.2.3 Late Attendance

Late Attendance is defined as the ability to vote despite a delegate has not participated in a previous attendance check. The CU allows late attendance.

In order to keep a correct attendance check result, the CU actually updates the attendance check result if late attendance occurs during a voting session.

After completion of a voting session, the attendance check result consists of delegates, who participated in the actual attendance check plus delegates participating only in the voting session (late attendance).

2.3 Notation

The RS232 protocol is defined byte for byte (1 byte = 8 bits). This document uses the following notation to describe these bytes:

Type of notation	Syntax	Example
ASCII representation	’value’	‘m’
Decimal representation	<value>	<109>
Hexadecimal representation	[value]	[6D]

The example shows, that the byte-value of the 8-bits ..01101001..
can be perceived as the ASCII character ‘m’, as the decimal value 109 or as the hexadecimal value 0x6D.

3 Serial Protocol

All communication between the CU and the external control unit is done through a serial connection either via RS232 or RS422. The format of the serial data is 8 data bits, 1 stop bit and no parity. Possible bit rates are 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bits/s. The default is 115200 bits/s. Hardware flow control is used on the serial port.

The CU provides a possibility to save the settings in a configuration. Whenever the CU powers up, the settings stored in the configuration are applied. The bit rate setting is part of the configuration, and is applied after power up.

3.1 Package format

Communication between the CU and an external control unit consists of binary packages (messages). Each binary message consists of bytes. The format of the packages sent between the CU and the external control unit is as follows:

```
<START> <Message Type> <ID> <Data Byte 0> . . . <Data Byte N> <CRC> <STOP>
```

START is the constant 0xFC that indicates the start of a message
Message Type is a byte indicating the type of the message. The message types used is described in section 3.4.
ID is a byte identifying this message in a stream of messages. Each time a message is sent this number is incremented. When the maximum allowed value, 63, is reached the counter is wrapped. Separate counters are used for message from the CU and messages to the CU.
Data byte 0 – ***Data byte N*** is the actual message to be sent.
CRC is an 8-bit CRC value for the message. The CRC is calculated over the bytes between the *Start* and *CRC*. The calculation is described in section 3.2.
STOP is the constant 0xFD that indicates the end of a message.

3.2 CRC Calculation

An 8-bit CRC calculation with the polynomial x^8+x^2+x+1 is used for the serial communications. A C implementation of a function calculating the CRC value of a message is given below:

```
unsigned char CalcCRC(unsigned char *Message, unsigned char Length)
{
  UCHAR Crc;
  UINT k;

  Crc = 0;
  for (k=0; k < Length; k++)
    Crc = CrcTable[Crc ^ (*Message++)];

  return Crc;
}
```

The variable *CrcTable* used above refers to this array:

```
unsigned char CrcTable[]={
   0,    7,   14,    9,   28,   27,   18,   21,   56,   63,   54,   49,   36,   35,   42,   45,
 112,  119,  126,  121,  108,  107,   98,  101,   72,   79,   70,   65,   84,   83,   90,   93,
 224,  231,  238,  233,  252,  251,  242,  245,  216,  223,  214,  209,  196,  195,  202,  205,
 144,  151,  158,  153,  140,  139,  130,  133,  168,  175,  166,  161,  180,  179,  186,  189,
 199,  192,  201,  206,  219,  220,  213,  210,  255,  248,  241,  246,  227,  228,  237,  234,
 183,  176,  185,  190,  171,  172,  165,  162,  143,  136,  129,  134,  147,  148,  157,  154,
  39,   32,   41,   46,   59,   60,   53,   50,   31,   24,   17,   22,    3,    4,   13,   10,
  87,   80,   89,   94,   75,   76,   69,   66,  111,  104,   97,  102,  115,  116,  125,  122,
 137,  142,  135,  128,  149,  146,  155,  156,  177,  182,  191,  184,  173,  170,  163,  164,
 249,  254,  247,  240,  229,  226,  235,  236,  193,  198,  207,  200,  221,  218,  211,  212,
 105,  110,  103,   96,  117,  114,  123,  124,   81,   86,   95,   88,   77,   74,   67,   68,
  25,   30,   23,   16,    5,    2,   11,   12,   33,   38,   47,   40,   61,   58,   51,   52,
  78,   73,   64,   71,   82,   85,   92,   91,  118,  113,  120,  127,  106,  109,  100,   99,
  62,   57,   48,   55,   34,   37,   44,   43,    6,    1,    8,   15,   26,   29,   20,   19,
 174,  169,  160,  167,  178,  181,  188,  187,  150,  145,  152,  159,  138,  141,  132,  131,
 222,  217,  208,  215,  194,  197,  204,  203,  230,  225,  232,  239,  250,  253,  244,  243};
```

The CRC calculation is done byte by byte, starting with the Message Type and ending with the last data byte, both included.

Examples on CRC calculations are found in section 5.1

3.3 Encoding

Since the values used for the start and stop delimiters occasionally have to be used inside the messages, the data in the packets are encoded to avoid using these values. In order to achieve this a third control value *Escape*, with the value 0xFE, is introduced. Whenever one of the values 0xFC, 0xFD and 0xFE are needed in a message, they are replaced with a two byte sequence as detailed here:

Value to be sent	Encoded as
0xFC	{Escape} 0
0xFD	{Escape} 1
0xFE	{Escape} 2

Encoding of the contents of the binary message is done after the CRC calculation.

3.4 Message types

The following sections describe the types of messages that are sent between the CU and the external control unit. For each message type the format of the messages of this type is shown, this description excludes the start/stop delimiters and the CRC. The field <ID> in the following descriptions refers to the identifier byte introduced in section 3.1.

3.4.1 CU reset (CU → external)

When the CU powers up, it transmits a binary message on the serial interface, in order to inform external control units, that the DCS 6000 system (CU) has been turned on.

The format of the CU reset message is:

```
<START> ‘r’ <ID> <CRC> <STOP>
```

3.4.2 Change binary Control Mode (external → CU)

This message is sent from the external controller to the CU in order to change the binary control mode of the serial interface. The message format is either

```
<START> ‘m’ <ID> ‘c’ ‘m’ <CRC> <STOP>
```

which changes the mode to microphone control mode. Or

```
<START> ‘m’ <ID> ‘q’ <CRC> <STOP>
```

which leaves the microphone control mode.

3.4.3 Send Control Message to CU (external → CU)

This message is used to send a DCS 6000 message to the CU asking it to perform some operation or deliver some data. The messages available are discussed in section 4.3. The format of the message is:

```
<START> ‘j’ <ID> <Chain> <MSB addr> <LSB Addr> <Message Group> <Data 1> <Data 2> <Data 3> <CRC> <STOP>
```

Chain is the chain number the control job originates from. This field exists because the command can be used to simulate control jobs originating from messages on the DCS 6000 bus. Just set this value to 0.
LSB addr and ***MSB addr*** are the least respectively the most significant bytes of the external control units address. See section 5.2 on how to obtain a unique address for an external control unit.
Message Group defines the message group of the message to send. The message groups are defined in section 4.3.

Data 1, ***Data 2*** and ***Data 3*** are the actual data bytes to send to the CU. Typically the function to be executed is defined by *Message Group + Data 1* while *Data 2* and *Data 3* are the parameters top the function. In the case that not all of the data bytes are needed the rest are set to 0.

3.4.4 Receive Control Message from CU (CU → external)

This message encapsulates DCS 6000 commands sent from the CU to external control unit. The format of the message is

```
<START> 'c' <ID> <MSB addr> <LSB addr> <Message Group> <len> <Data 1>..<Data N> <CRC> <STOP>
```

MSB addr and ***LSB addr*** are the least respectively the most significant bytes of the address of the receiver of the message. The external controller should only take note of the message if the address is its own or the group address for a group it is currently a member of. See section 4.2 for a list of relevant group addresses.
Message Group is the message group of the message sent by the CU. The message groups are defined in section 4.5.
Len is the number of data send (N)
Data 1 to ***Data N*** are the data bytes sent in the message.

3.5 Building a control message – step by step

When a message is to be transferred via the serial connection, the follow steps are done in the order shown below:

1. The Message Type and contents is decided.
   <Message Type> <Data Byte 0> . . . <Data Byte N>

2. ID is added.
   <Message Type> **<ID>** <Data Byte 0> . . . <Data Byte N>

3. CRC check sum is added.
   <Message Type> **<ID>** <Data Byte 0> . . . <Data Byte N> **<CRC>**

4. Encoding of the message is done with respect to escape characters
   <Message Type> **<ID>** <Data Byte 0> . . . <Data Byte N> <CRC>

5. Finally, START and STOP delimiters are added.
   <START> <Message Type> **<ID>** <Data Byte 0> . . . <Data Byte N> <CRC> **<STOP>**

4 DCS 6000 Messages

The RS232 binary protocol is used to transfer DCS 6000 system commands between the CU and the external control unit. General definitions for the communication are described in sections 3.4.3 and 3.4.4. This section describes the details for the commands that can be sent via the RS232 protocol.

4.1 Addresses in the DCS 6000 system

Units, connected to the CU and provided with ability to initiate communication in the DCS 6000 system are assigned unique addresses. This goes for microphone units, interpreter sets and for external control units as well. The CU is responsible for assigning addresses to various units.

Addresses are assigned in a random order at the first power up of the CU.

In order to obtain an address, an external control unit must pass through a registration. See section 5.2.

External control units are assigned addresses in the range 3900-3999 or 4040-4049.

Unique addresses allow the CU to send control messages directly to a single unit. Furthermore, it is possible for the CU to distinguish the sender of a control message from all other unit by means of the unique address.

4.2 Group addresses

All messages sent from the CU is either directed at a single unit or at a group of units identified by a group address. The group addresses that the external controller is a member of is:

Group	Address	Comments
All units	4000	The external unit is always a member of this group
Control Units	4013	The external unit is always a member of this group

An external control unit must react only upon a control message carrying either the unique controller unit address or one of the above group addresses.

4.3 Messages from the external unit to the CU

The messages that an external control unit can send to the CU when the binary interface is in the microphone control mode are divided into three groups:

- The *EXTERNAL_CONTROL_GRP* group consisting of messages to do with the registering and monitoring of external control units. The value corresponding to *EXTERNAL_CONTROL_GRP* is 27.
- The *EXTERNAL_AUDIO_CONTROL_MU* group that contains messages for controlling the volume controls of the CU. The value corresponding to *EXTERNAL_AUDIO_CONTROL_MU* is 28.

- The *MICROPHONE_CONTROL_GRP* with messages regarding switching microphone on/off, controlling the request queue etc. The value corresponding to *MICROPHONE_CONTROL_GRP* is 18.
- The *VOTING_CONTROL_GRP* with messages to start and stop attendance check and voting sessions, and to request voting results. The value corresponding to *VOTING_CONTROL_GRP* is 52.

The following sections describe the messages from each message group.

4.3.1 Messages in EXTERNAL_CONTROL_GRP

The following subsections describe each of the messages in the group. The message format descriptions have the same meaning as in section 3.4.3.

EXTERNAL_NEW_UNIT

Command item value: 1

Message format:

```
<START> ‘j’ <ID> <0> <15> <173> <27> <1> <Capabilities> <External Identity> <CRC> <STOP>
```

This message is used by an external control unit to register to the CU. The result of registration in the CU is an address assigned to external control unit for unique identification. This message should be sent with the group address for external controllers (4013) as sender address.
When registering in the CU, the external control unit indicates, which functionality the external controller is capable of running. This is indicated by the parameter *Capabilities*:

Capabilities	Value	Description
Only Microphone Functionality	2	The external controller supports only microphone functionality.
Microphone and Voting Functionality	10	The external controller supports microphone functionality and also voting functionality (Open/Close voting sessions).

The registering unit to identify it can use the *External Identity*. The CU includes the *External Identity*, when the assigned address is transmitted to the external control unit. The *External Identity* can be assigned any 8-bit value; also 0.

EXTERNAL_HEART_BEAT_RESPONSE

Command item value: 4

Message format:

```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <27> <4> <0> <0> <CRC> <STOP>
```

The external control unit should send this message as reply to *EXTERNAL_HEART_BEAT_REQUEST* messages from the CU in order to indicate that the external controller is still present.

4.3.2 Messages in MICROPHONE_CONTROL_GRP

The following subsections describe each of the messages in the group. The message format descriptions have the same meaning as in section 3.4.3.

MICROPHONE_CONTROL_DELEGATE_OFF_ACTIVATE

Command item value: 1
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <1> <0> <0> <CRC> <STOP>

When this command is issued to the CU all active delegate microphones are deactivated (chairman units are unaffected) and cannot be reactivated until the delegate off is deactivated.

MICROPHONE_CONTROL_DELEGATE_OFF_DEACTIVATE

Command item value: 2
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <2> <0> <0> <CRC> <STOP>

This command is used to re-allow delegate microphones to be activated after *MICROPHONE_CONTROL_DELEGATE_OFF_ACTIVATE* has been used.

MICROPHONE_CONTROL_MUTE_ACTIVATE

Command item value: 3
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <3> <0> <0> <CRC> <STOP>

This command mutes all delegate microphones (chairman units are unaffected).

MICROPHONE_CONTROL_MUTE_DEACTIVATE

Command item value: 4
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <4> <0> <0> <CRC> <STOP>

This command is used to un-mute the delegate microphones after the above command has been used.

MICROPHONE_CONTROL_NEXT_ON

Command item value: 7
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <7> <0> <0> <CRC> <STOP>

Disables the delegate microphone that has been active for the longest time, and activates the first delegate microphone in the request list.

MICROPHONE_CONTROL_CLEAR_REQUEST_LIST

Command item value: 8
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <8> <0> <0> <CRC> <STOP>

Clears the request list.

MICROPHONE_CONTROL_SET_MAXSPEAKERS

Command item value: 12
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <12> <Max Speakers> <0> <CRC> <STOP>

Set the maximum number of simultaneously active delegate microphones to *Max Speakers*. Chairman units are not included in this count. Regardless of the setting of this parameter the maximum number of active microphones (delegates + chairmen) is 8. The range of *Max Speakers* is 0-8.

MICROPHONE_CONTROL_SET_MAXREQUESTS

Command item value: 13
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <13> <Max Requests> <0> <CRC> <STOP>

Sets the maximum number of delegates in the request queue to *Max Requests* the range is 0-255.

MICROPHONE_CONTROL_MICROPHONE_ON

Command item value: 14
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <14> <Microphone Addr MSB> <Microphone Addr LSB> <CRC> <STOP>

Activates the microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB*. See section 5.2 for a description of how to find the microphone addresses.

MICROPHONE_CONTROL_MICROPHONE_OFF

Command item value: 15
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <15> <Microphone Addr MSB> <Microphone Addr LSB> <CRC> <STOP>
Deactivates the microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB*.

MICROPHONE_CONTROL_REQUEST_ON

Command item value: 16
Message format:
```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <16> <Microphone Addr MSB> <Microphone Addr LSB> <CRC>
<STOP>
```
Places the delegate microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB* at the back of the request queue.

MICROPHONE_CONTROL_REQUEST_OFF

Command item value: 17
Message format:
```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <17> <Microphone Addr MSB> <Microphone Addr LSB> <CRC>
<STOP>
```

Remove the delegate microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB* from the request queue.

MICROPHONE_CONTROL_SYSTEM_OPERATION_MODE

Command item value: 18
Message format:
```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <18> <Operation Mode> <0> <CRC> <STOP>
```

This command is used to change the operation mode of the microphone application. The mode is set according to the value of *Operation Mode* with the following relation between the value and the new mode:

Operation Mode	Number
Auto	0
Manual	1
FIFO	2

MICROPHONE_CONTROL_REQUEST_SYSTEM_STATUS

Command item value: 20
Message format:
```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <20> <0> <0> <CRC> <STOP>
```

This command is used to prompt the CU for status messages describing the state of the microphone application. The messages that the CU sends as answer to this are described in section 4.5.2.

4.3.3 MICROPHONE_PRIORITY

This message is used to setup the speak priority for microphone units (chairman units and delegate units).

Message format:

```
<START> 'j' <ID> <0> <MSB addr> <LSB Addr> <25> <Microphone Addr MSB> <Microphone Addr LSB> <Speak Priority> <CRC> <STOP>
```

The message defines the microphone speak priority for the microphone unit, which has the address 256* Microphone Addr MSB + Microphone Addr LSB to the value of the Speak Priority.

The speak priority defines the rights of a microphone unit, according to the following table:

Speak Priority	Description
0	No right to speak
1	Default delegate priority
2,3,4	High delegate priorities
5	Chairman priority

Default, delegate microphone units are assigned a speak priority of 1, and chairman units are assigned a speak priority of 5.

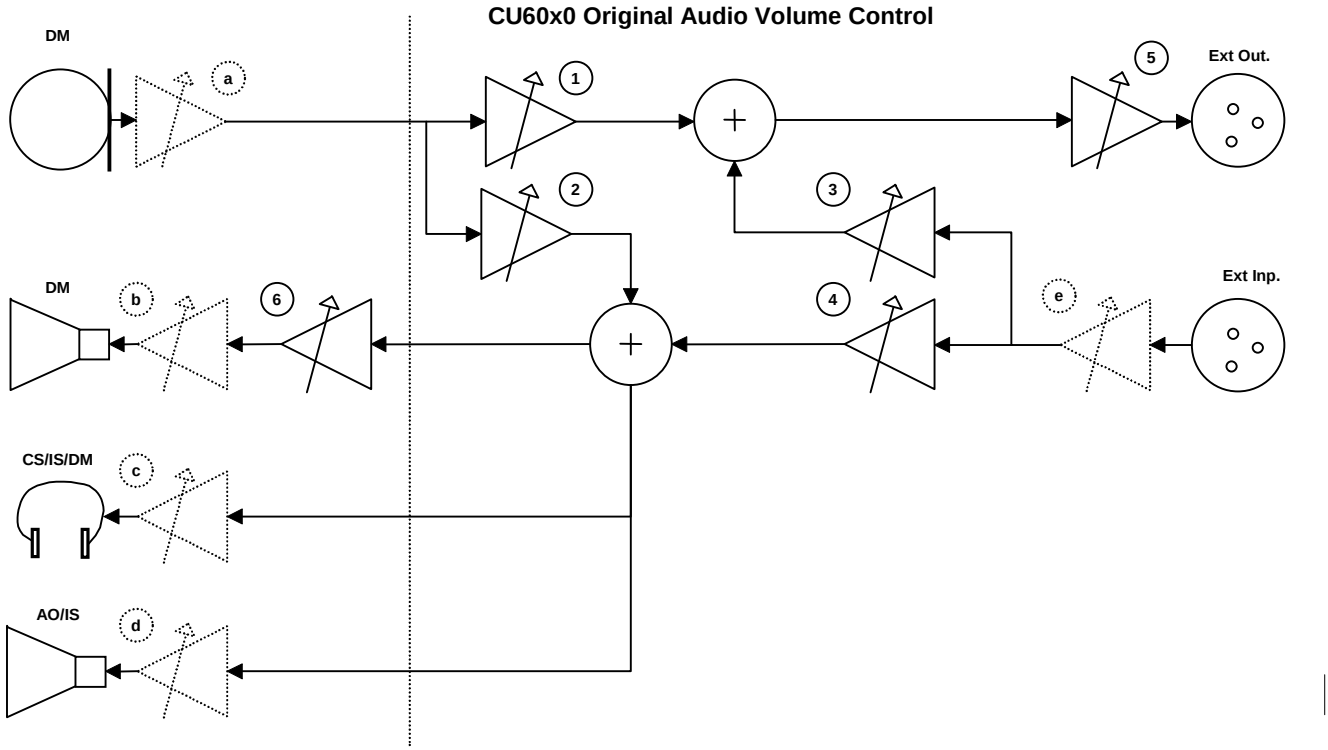
The speak priority 0 should only be assigned to units, where the user is not allowed to turn on the microphone.

In the operation modes Manual and FIFO, the request lists is ordered in accordance with microphone speak priorities. Microphone units with high speak priorities always preceedes units with default speak priority. Units with speak priority of 0 are not allowed into the request list. Furthermore, the request list does not apply to chairman units either. No matter the operation mode, a unit with chairman priority is always turned on, when pressing the Speak button.

4.3.4 Messages in EXTERNAL_AUDIO_CONTROL_MU

The messages in this message group are used to control the settings of the amplifiers in the system. The numbers

The messages in this message group are used to control the settings of the amplifiers in the system. The numbers used to specify the amplifiers in the description of each message refers to the diagram below.



The following sections describe each of the messages from this group. The first data byte in each message is called the command item. The sections are named after the command item for the message. The message format in each section only includes the data bytes following the command item.

AUDIO_CONTROL_MU_SPEAKER_VOLUME

Command item value: 2
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <28> <2> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier 6. The new gain is given in dB by the parameter *Gain Level* which must be in the range –41dB - 0dB. Setting the gain to –41dB results in switching the amplifier off (thus blocking the signal).

AUDIO_CONTROL_MU_SPEAKER_UP

Command item value: 3
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <28> <3> <0> <0> <CRC> <STOP>

This command increments the gain in amplifier 6. If the gain is already set to 0dB nothing happens.

AUDIO_CONTROL_MU_SPEAKER_DOWN

Command item value: 4
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <28> <4> <0> <0> <CRC> <STOP>

This command decrements the gain in amplifier 6. If the amplifier is switched off nothing happens. If the gain is set to -40dB before the command is issued the amplifier is switched off.

AUDIO_CONTROL_MU_LINE_OUT_VOLUME

Command item value: 5
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <28> <5> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier 5. The new gain is given in dB by the parameter *Gain Level* which must be in the range –41dB - + 20dB. –41dB results in switching the amplifier off (thus blocking the signal).

AUDIO_CONTROL_MU_MIC_TO_SPEAKER

Command item value: 6
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <28> <6> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier 2. The new gain is given in dB by the parameter *Gain Level* which must be in the range –41dB - + 20dB. –41dB results in switching the amplifier off (thus blocking the signal).

AUDIO_CONTROL_MU_MIC_TO_LINE_OUT

Command item value: 7
Message format:
<START> 'j' <ID> <0> <MSB addr> <LSB Addr> <28> <7> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier 1. The new gain is given in dB by the parameter *Gain Level* which must be in the range –41dB - + 20dB. –41dB results in switching the amplifier off (thus blocking the signal).

AUDIO_CONTROL_MU_LINEIN_TO_SPEAKER

Command item value: 8
Message format:
<START> 'j' <ID> <0> <MSB addr> <LSB Addr> <28> <8> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier 4. The new gain is given in dB by the parameter *Gain Level* which must be in the range –41dB - + 20dB. –41dB results in switching the amplifier off (thus blocking the signal).

AUDIO_CONTROL_MU_LINEIN_TO_LINEOUT

Command item value: 9
Message format: <START> 'j' <ID> <0> <MSB addr> <LSB Addr> <28> <9> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier 3. The new gain is given in dB by the parameter *Gain Level* which must be in the range –41dB - + 20dB. –41dB results in switching the amplifier off (thus blocking the signal).

AUDIO_CONTROL_MU_LINE_IN_LEVEL

Command item value: 13
Message format:
<START> 'j' <ID> <0> <MSB addr> <LSB Addr> <28> <13> <Gain Level> <0> <CRC> <STOP>

This command is used to set the gain in amplifier *e*. The new gain is given in dB by the parameter *Gain Level*. The range for *Gain Level* is –37dB – 0dB with –37 meaning off.

AUDIO_CONTROL_MU_REQUEST_STATUS

Command item value: 20
Message format:
<START> 'j' <ID> <0> <MSB addr> <LSB Addr> <28> <20> <0> <0> <CRC> <STOP>

This message is used to prompt the CU for status messages describing the gain settings of the amplifiers in the system. The messages the CU sends as answer to this are described in section 4.5.3.

4.3.5 Messages in Voting_CONTROL_GRP

The following control messages controls voting sessions and attendance check sessions in the CU. Again, the message format descriptions have the same meaning as in section 3.4.3.

COMMAND_ITEM_VOTING_CONTROL_TYPE_OF_VOTING

Command item value: 1

Message format:

```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <1> <Type of Voting> <0> <CRC> <STOP>
```

The Type of Voting parameter defines, which type of voting session is to take place. Type of Voting is defined prior to execution of a voting session.

Type of Voting	Value	Description
3-Button Voting	3	Three voting alternatives will be available – typically Yes, Abstain and No.
5-Button Voting	5	Five voting alternatives will be available – typically ++, +, 0, - and --.

COMMAND_ITEM_VOTING_CONTROL_SECRET_VOTING

Command item value: 3

Message format:

```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <3> <Secret Voting> <0> <CRC> <STOP>
```

The Secret Voting parameter defines, whether votes are kept secret by the system, or whether it is acceptable for delegates to view votes cast by other delegates..

Secret Voting	Value	Description
Open voting	0	Votes are revealed by the DCS6000 system.
Secret Voting	1	Votes are kept secret by the DCS6000 system. Units do not reveal votes, and the CU does not distribute status of cast votes to external control units, only the interim/final results.

VOTING_CONTROL_START_ATTENDANCE_CHECK

Command item value: 11

Message format:

```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <11> <0> <0> <CRC> <STOP>
```

An attendance check (or presence check) among delegates is conducted in order to determine, how many are actually participating the meeting – how many votes can be cast from the present delegates. This command is sent to the CU to start an attendance check. If the CU accepts the command to start an attendance check, it issues the *VOTING_STATUS_ATTENDANCE_CHECK_STARTED* message of the *VOTING_STATUS_GRP*.

As soon as an attendance check session is started, the CU continuously informs the external control unit about the current result (interim result). Two times every second, the CU sends the message *VOTING_STATUS_INTERIM_ATTENDANCE_CHECK_RESULT* carrying the latest result. Be aware, that the CU distinguishes between interim result and final result – while the attendance check is running the CU only sends VOTING_STATUS_INTERIM_ATTENDANCE_CHECK_RESULT (including interim result) – when the attendance check is finished the CU only sends VOTING_STATUS_ATTENDANCE_CHECK_RESULT (including final result).

When a delegate presses the ‘Present’ button, the CU sends a *UNIT_ATTENDANCE_STATUS_GRP* message with information about the microphone unit address(es), where the present button(s) was pressed. If the activity among the delegates is high, the CU gathers several addresses in one *UNIT_ATTENDANCE_STATUS_GRP* message. Notice, in order to be able to deliver as much information as possible a dedicated message group is used for this purpose. It is thereby possible to convey information of up to 4 present delegates in one message.

When an attendance check is started, it continues until it is stopped from the external control (see the *VOTING_CONTROL_STOP_ATTENDANCE_CHECK* message below).

In case the CU experiences faults in communication, it cancels the ongoing attendance check session and issues *VOTING_STATUS_ATTENDANCE_CHECK_CANCELLED.*

It is not possible to start an attendance check, while a voting session is running.

VOTING_CONTROL_STOP_ATTENDANCE_CHECK

Command item value: 12
Message format:

```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <12> <0> <0> <CRC> <STOP>
```

This command is used to stop an ongoing attendance check. The CU acknowlegdes the command by the VOTING*_STATUS_ATTENDANCE_CHECK_STOPPED* followed by the final attendance check result (*VOTING_STATUS_ATTENDANCE_CHECK_RESULT*).

VOTING_CONTROL_REQUEST_ATTENDANCE_RESULT

Command item value: 14

Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <14> <0> <0> <CRC> <STOP>

Once an attendance check has been completed successfully, the external control unit can request the attendance check result. The attendance check result remains in the CU until the next attendance check session is started, or until the CU is reset.

The *VOTING_CONTROL_REQUEST_ATTENDANCE_RESULT* results in the CU repeating the information about all microphone unit addresses, where the ‘Present’ button was pressed (*UNIT_ATTENDANCE_CHECK_GRP*) followed by the final attendance check result (*VOTING_STATUS_ATTENDANCE_CHECK_RESULT).*

VOTING_CONTROL_OPEN_VOTING

Command item value: 16
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <16> <0> <0> <CRC> <STOP>

This command is issued to start a voting session in the CU. The CU responds to the command by *VOTING_STATUS_VOTING_OPENED,* and hereafter the delegates may cast their votes from the microphone units. A voting session cannot be started, if an attendance check is running.

Once the voting session is running, the CU continuously informs about votes cast, and the current results (interim results). Two times per second, the CU sends informs about the interim results of each voting alternative (Yes, Abstain and No), this is done using the control message *VOTING_STATUS_INTERIM_VOTING_RESULT*.

Each vote cast by a delegate is informed to the external control unit with the control message *UNIT_VOTE_STATUS_GRP*. This includes information about the microphone unit address, where the delegate is located, and the vote that was cast. Also here, a dedicated message group is used, so that it is possible for the CU to send information of up to 4 votes in one message.

The voting session continues until it is closed by the external controller (using the command *VOTING_CONTROL_CLOSE_VOTING – see below*). Or until the CU experiences communication faults, in which case the voting session is cancelled (*VOTING_STATUS_VOTING_CANCELLED*).

VOTING_CONTROL_CLOSE_VOTING

Command item value: 18
Message format:
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <52> <18> <0> <0> <CRC> <STOP>

A voting session is closed by this command. Closing a voting session results in the CU acknowledging by the final voting results *VOTING_STATUS_VOTING_RESULTS* (one message per voting option)

followed by the message *VOTING_STATUS_VOTING_CLOSED*. Notice, the order of these messages is opposite to the attendance check.

VOTING_CONTROL_REQUEST_VOTING_DETAILS

Command item value: 21

Message format:

```
<START> 'j' <ID> <0> <MSB addr> <LSB Addr> <52> <21> <0> <0> <CRC> <STOP>
```

Also, the result of a voting session remains in the CU until start of the next voting session or reset of the CU. With this command the CU is requested to deliver the details of the latest completed voting session.

The voting result consists of individual votes; which vote was cast from which microphone unit (*UNIT_VOTE_STATUS_GRP*) followed by the final voting result of each voting option (*VOTING_STATUS_VOTE_RESULTS*).

4.4 Summary of control messages (External Unit → CU)

The table below lists all the commands available for an external control unit to control the CU.

EXTERNAL_CONTROL_GRP (=27):

Command Item	value	Comment
EXTERNAL_NEW_UNIT	1	Request registration in the CU
EXTERNAL_HEART_BEAT_RESPONSE	4	Confirm that the RS232 connection is working

MICROPHONE_CONTROL_GRP (=18):

Command Item	value	Comment
MICROPHONE_CONTROL_DELEGATE_OFF_ACTIVATE	1	Activate the Delegate Off.
MICROPHONE_CONTROL_DELEGATE_OFF_DEACTIVATE	2	Deactivate the Delegate Off
MICROPHONE_CONTROL_MUTE_ACTIVATE	3	Mute all delegates
MICROPHONE_CONTROL_MUTE_DEACTIVATE	4	Stop muting all delegates
MICROPHONE_CONTROL_NEXT_ON	7	Turn on the first delegate from the delegate list
MICROPHONE_CONTROL_CLEAR_REQUEST_LIST	8	Clear the request list
MICROPHONE_CONTROL_SET_MAXSPEAKERS	12	Set the maximum number of open delegate microphones
MICROPHONE_CONTROL_SET_MAXREQUESTS	13	Set the size of the request list

MICROPHONE_CONTROL_MICROPHONE_ON	14	Turn on a delegate microphone.
MICROPHONE_CONTROL_MICROPHONE_OFF	15	Turn off a delegate microphone
MICROPHONE_CONTROL_REQUEST_ON	16	Set a delegate in the request list
MICROPHONE_CONTROL_REQUEST_OFF	17	Remove a delegate from the request list
MICROPHONE_CONTROL_SYSTEM_OPERATION_MODE	18	Set the operation mode of the system
MICROPHONE_CONTROL_REQUEST_SYSTEM_STATUS	20	Request status of the microphone system.

MICROPHONE_PRIORITY (=25):
This message group is not split further into command items.

EXTERNAL_AUDIO_CONTROL_MU (=28):

Command Item	**value**	**Comment**
AUDIO_CONTROL_MU_SPEAKER_VOLUME	2	Set the volume of delegate loudspeakers
AUDIO_CONTROL_MU_SPEAKER_UP	3	Increment the volume of delegate loudspeakers
AUDIO_CONTROL_MU_SPEAKER_DOWN	4	Decrement the volume of delegate loudspeakers
AUDIO_CONTROL_MU_LINE_OUT_VOLUME	7	Set the volume of LineOut
AUDIO_CONTROL_MU_MIC_TO_SPEAKER	8	Adjust the audio level from speaking delegates to delegate loudspeakers
AUDIO_CONTROL_MU_MIC_TO_LINE_OUT	12	Adjust the audio level from speaking delegates to LineOut
AUDIO_CONTROL_MU_LINEIN_TO_SPEAKER	13	Adjust the audio level from LineIn to delegate loudspeakers
AUDIO_CONTROL_MU_LINEIN_TO_LINEOUT	14	Adjust the audio level from LineIn to LineOut
AUDIO_CONTROL_MU_LINE_IN_LEVEL	15	Set the LineIn level.
AUDIO_CONTROL_MU_REQUEST_STATUS	16	Request the audio settings.

VOTING_CONTROL_MU (=52):

Command Item	value	Comment
VOTING_CONTROL_TYPE_OF_VOTING	1	3-Button or 5-Button voting.
VOTING_CONTROL_SECET_VOTING	3	Open or Secret voting.
VOTING_CONTROL_START_ATTENDANCE_CHECK	11	Start an attendance check
VOTING_CONTROL_STOP_ATTENDANCE_CHECK	12	Stop an attendance check
VOTING_CONTROL_REQUEST_ATTENDANCE_RESULT	14	Request the CU to deliver the results of the most recent attendance check.
VOTING_CONTROL_OPEN_VOTING	16	Open (=start) a voting session.
VOTING_CONTROL_CLOSE_VOTING	18	Close (=end) a voting session.
VOTING_CONTROL_REQUEST_VOTING_DETAILS	21	Request the CU to deliver the results of the most recent voting session.

4.5 Messages from the CU to the external unit

When the binary service interface is in the microphone control mode the CU sends messages in the following message groups to the external controller:

- The *MAIN_GRP* group with messages regarding the connection and disconnection of microphone units. The value corresponding to this group is 0.
- The *EXTERNAL_AUDIO_STATUS_MU_GRP* group consisting of status messages about the settings of the amplifiers in the system. The value corresponding to this group is 29.
- The *MICROPHONE_STATUS_GRP* group that contains messages about the status of the microphone application. The value corresponding to this group is 23.
- The *EXTERNAL_CONTROL_GRP* group used in the registering and monitoring of external control units. The value corresponding to this group is 27.
- The *VOTING_STATUS_GRP* group that informs about attendance check and voting sessions. The value corresponding to this group is 53.
- The *UNIT_ATTENDANCE_CHECK_GRP* group informs about microphone unit addresses of delegates, who has pressed the ‘Present’ button. The value corresponding to this group is 58.
- The *UNIT_VOTE_STATUS_GRP* group used by the CU to inform about votes and unit address from votes cast from microphone units. The value corresponding to this group is 69.

Messages in MAIN_GRP

The following subsections describe each of the messages in the group. The message format descriptions have the same meaning as in section 3.4.4.

MAIN_FOUND_UNIT

Command item value: 26

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <0> <8> <26> <Unit Type> <Addr MSB> <Addr LSB> <SerialNumber
Byte 1> <SerialNumber Byte 2> <SerialNumber Byte 3> <Unit Functionality> <CRC> <STOP>
```

The CU sends this message to the external control unit when a new unit is registered. The *Unit Type* field specifies what type of unit was registered. The relation between the unit type and the number is shown in the table below.

Type of unit	Unit Type Number
Delegate Microphone	1
MU Box Delegate Microphone	6
Chairman Microphone	2
MU Box Chairman Microphone	7

Messages reporting about other unit types can be ignored.

The CU has assigned the address 256**Address MSB* + *Address LSB* to the new unit. The serial number for the unit is stored in the three bytes *Serial Number 1*, *Serial Number 2* and *Serial Number 3*. On the boxes and the displays of the units the serial numbers are written as three numbers between 0 and 255 with dots between (*Serial Number 1*.*Serial Number 2*.*Serial Number 3*).

The Unit Functionality indicates support for chip card, voting and microphone sharing – to be disregarded.

MAIN_LOST_UNIT

Command item value: 4

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <0> <8> <4> <Unit Type> <Addr MSB> <Addr LSB> <SerialNumber Byte
1> <SerialNumber Byte 2> <SerialNumber Byte 3> <Unit Functionality> <CRC> <STOP>
```

The CU sends this message to the external control unit when a unit is lost (for example if it is disconnected from the system or the communication with the unit breaks down because of faulty cables). The parameters are the same as for the *MAIN_FOUND_UNIT* message.

4.5.1 Messages in EXTERNAL_CONTROL_GRP

The following subsections describe each of the messages in the group. The message format descriptions have the same meaning as in section 3.4.4.

EXTERNAL_UNIT_ADDRESS

Command item value: 2
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <27> <4> <2> <Addr MSB> <Addr LSB> <External Identity> <CRC>
<STOP>
```

The CU sends this message to tell the external control unit what address it has been assigned. The address is 256**Address MSB + Address LSB.*
The *External Identity* is the value, which the registering unit has already sent to the CU.

EXTERNAL_HEART_BEAT_REQUEST

Command item value: 3
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <27> <2> <3> <Error Information> <CRC> <STOP>
```

The CU periodically requests a “heart beat“ from the external control unit by sending this message. The external control unit is required to respond to this message with an EXTERNAL_HEART_BEAT_RESPONSE message. This is done in order to monitor if the external controller is still present. This message is always sent to the *control units* group address (4013).
The message includes error information from the CU – to be disregarded.

4.5.2 Messages in MICROPHONE_STATUS_GRP

The following subsections describe each of the messages in the group. The message format descriptions have the same meaning as in section 3.4.4.

MICROPHONE_STATUS_DELEGATE_OFF_ACTIVE

Command item value: 1
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <3> <1> <Control Unit Addr MSB> <Control Unit Addr LSB>
<CRC> <STOP>
```

This message is sent when a control unit/chairman unit activates the delegate off mode. The address of the unit that issued the command to enter this mode is 256**Control Unit Address MSB + Control Unit Address LSB.*

MICROPHONE_STATUS_DELEGATE_OFF_INACTIVE

Command item value: 2
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <4> <2> <Control Unit Addr MSB> <Control Unit Addr LSB>
<Delegate Off Status> <CRC> <STOP>
```

This message signifies that a control/chairman unit that previously made the system enter the delegate off mode no longer requires this mode to be active. The address of the unit is 256**Control Unit MSB + Control Unit LSB.*

The *Delegate Off Status* indicates whether the delegate off restriction is imposed to the system by another control units/chairman unit.

MICROPHONE_STATUS_DELEGATE_MUTE_ACTIVE

Command item value: 3
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <3> <3> <Control Unit Addr MSB> <Control Unit Addr LSB>
<CRC> <STOP>
```

The unit with address 256**Control Unit Addr MSB* + *Control Unit Addr LSB* has muted the delegate microphones.

MICROPHONE_STATUS_DELEGATE_MUTE_INACTIVE

Command item value: 4
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <4> <4> <Control Unit Addr MSB> <Control Unit Addr LSB>
<Mute Status> <CRC> <STOP>
```

The unit with address 256**Control Unit MSB* + *Control Unit LSB* that previously had the delegate microphones muted no longer requires this.
The Mute Status indicates whether another control unit/chairman unit is muting the delegate microphones.

MICROPHONE_STATUS_MICROPHONE_IN_REQUEST

Command item value: 7
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <4> <7> <Microphone Addr MSB> <Microphone Addr LSB>
<Request Position> <CRC> <STOP>
```

This message signifies that the microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB* is in the request queue at position *Request Position* (where position 1 is the first to be allowed to speak).
This message is only delivered as part of a microphone system status; it does not necessarily indicate a recent change of the status of the concerned microphone.

MICROPHONE_STATUS_MICROPHONE_IN_SPEAK

Command item value: 8
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <3> <8> <Microphone Addr MSB> <Microphone Addr LSB> <CRC>
<STOP>
```

The microphone with the address 256**Microphone Address MSB + Microphone Address LSB* is active.
This message is only delivered as part of a microphone system status; it does not necessarily indicate a recent change of the status of the concerned microphone.

MICROPHONE_STATUS_MICROPHONE_ON

Command item value: 9
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <3> <9> <Microphone Addr MSB> <Microphone Addr LSB> <CRC>
<STOP>
```

The CU sends this message to signal that the microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB* has been activated.

MICROPHONE_STATUS_MICROPHONE_OFF

Command item value: 10
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <3> <10> <Microphone Addr MSB> <Microphone Addr LSB> <CRC>
<STOP>
```

The CU sends this message to signal that the microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB* has been deactivated.

MICROPHONE_STATUS_REQUEST_ON

Command item value: 11
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <4> <11> <Microphone Addr MSB> <Microphone Addr LSB>
<Request Position> <CRC> <STOP>
```

This message signifies that the microphone with the address 256**Microphone Address MSB* + *Microphone Address LSB* has been put in the request queue at position *Request Position*.

MICROPHONE_STATUS_REQUEST_OFF

Command item value: 12
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <4> <12> <Microphone Addr MSB> <Microphone Addr LSB>
<Request Position> <CRC> <STOP>
```

This message is sent when the unit with the address 256**Microphone Address MSB* + *Microphone Address LSB* has been removed from the request queue (either because it's deleted from the list or because it's moved to the speak list) while it was at position *Request Position*. The external control unit should use this message and MICROPHONE_STATUS_REQUEST_ON to maintain its own copy of the request queue.

MICROPHONE_STATUS_MAX_REQUESTS

Command item value: 14
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <2> <14> <Max Requests Value> <CRC> <STOP>
```

Sent to signify that the maximum number of requests allowed in the queue has been set to *Max Requests Value*. The message is sent both when the value has been changed and as part of the system status.

MICROPHONE_STATUS_MAX_SPEAKERS

Command item value: 15
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <2> <15> <Max Speakers Value> <CRC> <STOP>
```

Sent to signify that the maximum number of simultaneous active delegate microphones has been set to *Max Speakers Value*. The message is sent both when the value has been changed and as part of the system status.

MICROPHONE_STATUS_SYSTEM_OPERATION_MODE

Command item value: 16
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <3> <16> <Operation Mode> <All Units> <CRC> <STOP>
```

This message is sent to signify that the microphone application is in *Operation Mode* mode. The values used for *Operation Mode* are the same as in section 4.3.2.
The *All Units* indicate, whether the change of operation mode applies to all units – to be disregarded.

MICROPHONE_STATUS_MICROPHONE_UNIT_STATUS

Command item value: 18
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <8> <18> <Addr MSB> <Addr LSB> <SerialNumber Byte 1>
<SerialNumber Byte 2> <SerialNumber Byte 3> <Unit Type and Status> <Unit Functionality> <CRC> <STOP>
```
The *Unit Type and Status* includes the following information:

Information	Stored in	Meaning
Unit Type	Bits 0 – 3	1 → It is a delegate unit 2 → It is a chairman unit 6 → It is a delegate MU box 7 → It is a chairman MU box
Lost Indicator	Bit 4	0 → Not Lost 1 → Lost

The *Unit Functionality* is to be disregarded.

MICROPHONE_STATUS_UPDATE_START

Command item value: 19
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <1> <19> <CRC> <STOP>
```

The CU sends this message to tell that a complete update on the status of the microphone control application will be sent.

MICROPHONE_STATUS_UPDATE_STOP

Command item value: 20

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <1> <20> <CRC> <STOP>
```

The CU sends this message to tell that it has just finished sending a complete update on the status of the microphone control application.

MICROPHONE_STATUS_MICROPHONE_ACTIVITY_STATUS

Command item value: 22

Message format:

For CU versions 3.x.x the format is:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <6> <22> <Addr MSB> <Addr LSB> <State A> <Request Position>
<State B> <CRC> <STOP>
```

For CU versions 5.x.x the format is:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <23> <8> <22> <Addr MSB> <Addr LSB> <State A> <Request Position>
<State B> <Microphone Priority> <Individual Settings> <CRC> <STOP>
```

This message gives the following status information about the microphone with the address 256**Microphone Address MSB + Microphone Address LSB*

Information	Stored in	Meaning
Microphone State	Bit 0 of *State A*	1 → Microphone is on 0 → Microphone is off
Request State	Bit 1 of *State A*	1 → Microphone is in the request queue 0 → Microphone is not in the request queue
Microphone Mute State	Bit 2 of *State A*	1 → Microphone is muted 0 → Microphone is not muted
Request Position	*Request Position*	The microphones position in the request queue. This number is undefined if the microphones isn't in request.
Delegate Off State	Bit 0 of *State B*	1 → The microphone is a chairman unit and has activated the delegate off state. 0 → The microphone hasn't activated the delegate off state.
Muting State	Bit 1 of *State B*	1 → The microphone is a chairman unit muting the system 0 → The microphone does not mute the system.

4.5.3 Messages in EXTERNAL_AUDIO_STATUS_MU

The following subsections describe each of the messages in the group. The message format descriptions have the same meaning as in section 3.4.4. The amplifier numbers in the following refers to the diagram in section 4.3.3.

AUDIO_STATUS_MU_SPEAKER_VOLUME

Command item value: 2

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <2> <Gain Level> <CRC> <STOP>
```

The CU sends this message when the gain setting for amplifier 6 is changed. The new setting in dB is in the field *Gain Level*. A setting of –41dB signifies that the amplifier is switched off.

AUDIO_STATUS_MU_SPEAKER_ON

Command item value: 3

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <1> <3> <CRC> <STOP>
```

The CU sends this message when the speakers on the delegate microphones are switched on.

AUDIO_STATUS_MU_SPEAKER_OFF

Command item value: 4
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <1> <4> <CRC> <STOP>

The CU sends this message when the speakers on the delegate microphones are switched off.

AUDIO_STATUS_MU_LINEOUT_VOLUME

Command item value: 5
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <5> <Gain Level> <CRC> <STOP>

This message signifies that the gain setting of amplifier 5 have been changed to *Gain Level* dB. A setting of –41dB means the amplifier is switched off.

AUDIO_STATUS_MU_MIC_TO_SPEAKER

Command item value: 6
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <6> <Gain Level> <CRC> <STOP>

This message signifies that the gain setting of amplifier 2 have been changed to *Gain Level* dB. A setting of –41dB means the amplifier is switched off.

AUDIO_STATUS_MU_MIC_TO_LINEOUT

Command item value: 7
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <7> <Gain Level> <CRC> <STOP>

This message signifies that the gain setting of amplifier 1 have been changed to *Gain Level* dB. A setting of –41dB means the amplifier is switched off.

AUDIO_STATUS_MU_LINEIN_TO_SPEAKER

Command item value: 8
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <8> <Gain Level> <CRC> <STOP>

This message signifies that the gain setting of amplifier 8 have been changed to *Gain Level* dB. A setting of –41dB means the amplifier is switched off.

AUDIO_STATUS_MU_LINEIN_TO_LINEOUT

Command item value: 9
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <9> <Gain Level> <CRC> <STOP>
```

This message signifies that the gain setting of amplifier 3 has been changed to *Gain Level* dB. A setting of –41dB means the amplifier is switched off.

AUDIO_STATUS_MU_LINE_IN_LEVEL

Command item value: 14
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <2> <14> <Gain Level> <CRC> <STOP>
```

This message signifies that the gain setting of amplifier *e* have been changed to *Gain Level* dB. A setting of –41dB means the amplifier is switched off.

AUDIO_STATUS_MU_STATUS_START

Command item value: 20
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <1> <20> <CRC> <STOP>
```

This message is sent to signal that the CU will send a complete status of the audio settings (all of the above messages).

AUDIO_STATUS_MU_STATUS_STOP

Command item value: 21
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <29> <1> <21> <CRC> <STOP>
```

This message means that a complete audio settings status has just been sent.

4.5.4 Messages in VOTING_STATUS_GRP

The following subsections describe status messages of voting activity in the CU. The message format descriptions have the same meaning as in section 3.4.4.

VOTING_STATUS_TYPE_OF_VOTING

Command item value: 1
Message format:
```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <2> <1> <Type of Voting> <CRC> <STOP>
```

3-Button voting or 5-button voting.

Type of Voting	Value	Description
3-Button Voting	3	Three voting alternatives will be available – typically Yes, Abstain and No.
5-Button Voting	5	Five voting alternatives will be available – typically ++, +, 0, - and --.

VOTING_STATUS_SECRET_VOTING

Command item value: 3
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <3> <1> <Secret Voting> <CRC> <STOP>
```

The Secret Voting parameter defines, whether votes are kept secret by the system, or whether it is acceptable for delegates to view votes cast by other delegates..

Secret Voting	Value	Description
Open voting	0	Votes are revealed by the DCS6000 system.
Secret Voting	1	Votes are kept secret by the DCS6000 system.

VOTING_STATUS_ATTENDANCE_CHECK_STARTED

Command item value: 11
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <1> <11> <CRC> <STOP>
```

This message informs that an attendance has started in the CU.

VOTING_STATUS_ATTENDANCE_CHECK_STOPPED

Command item value: 12
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <1> <12> <CRC> <STOP>
```

This message informs that an attendance has stopped in the CU.

VOTING_STATUS_ATTENDANCE_CHECK_CANCELLED

Command item value: 13
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <1> <13> <CRC> <STOP>
```

This message informs that an attendance is cancelled by the CU.
This only happens in case of communication problems. After cancellation of an attendance check, the CU does not store any attendance check result.

VOTING_STATUS_INTERIM_ATTENDANCE_RESULT

Command item value: 14
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <3> <14> <MSB result> <LSB result> <CRC> <STOP>
```

While an attendance check is running, the CU informs about the interim attendance check result in this message twice every second. Two data bytes carry the interim result, and it interim result is found from the following calculation:

Interim Result = 256*MSB result + LSB result

VOTING_STATUS_ATTENDANCE_RESULT

Command item value: 15
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <3> <15> <MSB result> <LSB result> <CRC> <STOP>
```

When an attendance check completes, the CU informs about the final attendance check result in this message. Again, two data bytes carry the final result, and the final result is found from the following calculation:

Final Result = 256*MSB result + LSB result

Note that the CU may update attendance result during a voting session if a delegate who did not participate in the initial attendance check casts a vote during the voting session. This will cause the final attendance result message to be resend with updated result.

VOTING_STATUS_VOTING_OPENED

Command item value: 16
Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <1> <16> <CRC> <STOP>
```

This message informs that a voting session is opened in the CU. From this point on, it is possible for the delegates to cast their votes.

VOTING_STATUS_VOTING_CLOSED

Command item value: 18

Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <1> <18> <CRC> <STOP>

This message informs that a voting session is closed in the CU. Immediately before this message, the CU has distributed the final voting result (*VOTING_STATUS_VOTING_RESULTS*).

VOTING_STATUS_VOTING_CANCELLED

Command item value: 19
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <1> <19> <CRC> <STOP>

This message informs that a voting session is cancelled by the CU. No voting result is available after this.

VOTING_STATUS_INTERIM_VOTING_RESULTS

Command item value: 21
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <4> <21> <alternativ> <MSB result> <LSB result> <CRC> <STOP>

This message includes the interim voting result of one of the voting alternatives:

Alternativ=1	Number of Yes-votes	= 256*MSB result + LSB result
Alternativ=2	Number of Abstain-votes	= 256*MSB result + LSB result
Alternativ=3	Number of No-votes	= 256*MSB result + LSB result

VOTING_STATUS_VOTING_RESULTS

Command item value: 22
Message format:
<START> 'c' <ID> <MSB addr> <LSB addr> <53> <4> <21> <alternativ> <MSB result> <LSB result> <CRC> <STOP>

This message includes the final voting result of one of the voting alternatives:

Alternativ=1	Number of Yes-votes	= 256*MSB result + LSB result
Alternativ=2	Number of Abstain-votes	= 256*MSB result + LSB result
Alternativ=3	Number of No-votes	= 256*MSB result + LSB result

4.5.5 Messages in UNIT_ATTENDANCE_STATUS_GRP

This message group contains presence indications from microphone units, where the ‘Present’ button has been pressed. The group is not split into command items. Instead, it includes information of up to 4

microphone unit addresses, where delegates have acknowlegded their presence. The message format has the same meaning as in section 3.4.4.

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <58> <8> <Presence MSB addr1> <Presence LSB addr1> <Presence MSB addr2> <Presence LSB addr2> <Presence MSB addr3> <Presence LSB addr3> <Presence MSB addr4> <Presence LSB addr4> <CRC> <STOP>
```

For each of the 4 possible microphone unit addresses, 16 bits are transmitted from the CU – 12 bits for the address, 1 bit for presence indication and 3 bits are unused (=0):

The addresses of present units:

Address 1 = 16* <Presence MSB addr1> + <Presence LSB addr1[*Bit3-Bit0*]>
Presence Address 1 = <Presence LSB addr1[*Bit4*]>

Address 2 = 16* <Presence MSB addr2> + <Presence LSB addr2[*Bit3-Bit0*]>
Presence of Address 2 = <Presence LSB addr2[*Bit4*]>

Address 3 = 16* <Presence MSB addr3> + <Presence LSB addr3[*Bit3-Bit0*]>
Presence of Address 3 = <Presence LSB addr3[*Bit4*]>

Address 4 = 16* <Presence MSB addr4> + <Presence LSB addr4[*Bit3-Bit0*]>
Presence of Address 4 = <Presence LSB addr4[*Bit4*]>

The presence of a delegate has been confirmed positively only, if the address is not 0 and the Presence of Address bit is set for the related address.

Example:

Imagine, that the CU has received presence indications from microphone units with addresses 1 and 34. And, assume that the CU 'packs' the presence indications of both units in the same message. That results in the CU sending the following message:

```
<START> 'c' <ID> <15> <173> <58> <8> <0> <17> <2> <0> <0> <0> <0> <18> <CRC> <STOP>
```

Receiving address is:

256 * <MSB addr> + <LSB addr> = 256*15 + 173 = 4013

The CU sends this message to the address group 'Control Units', which has the value 4013.

For Address 1 we receive:

<Presence MSB addr1><Presence LSB addr1> = <0><17>

Address 1 = 16* <Presence MSB addr1> + <Presence LSB addr1 [Bit3-Bit0]>
= 16 * 0 + 1 = 1
Presence = <Presence LSB addr1 [Bit4]>
= 1 ***(Address 1 is present)***

For Address 2 we receive:
<Presence MSB addr2><Presence LSB addr2> = <2><18>

Address 2 = 16*2 + 2 = 34
Presence = 1 ***(Address 34 is present)***

For Address 3 and Address 4 there is no information (all is 0).

4.5.6 Messages in UNIT_VOTE_STATUS_GRP

This message group includes votes from microphone units. The message group is not split into command items. Instead, it includes information of up to 4 microphone unit addresses, where delegates have acknowlegded their presence. The message format has the same meaning as in section 3.4.4.

Message format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <58> <8> <Vote MSB addr1> <Vote LSB addr1> <Vote MSB addr2>
<Vote LSB addr2> <Vote MSB addr3> <Vote LSB addr3> <Vote MSB addr4> <Vote LSB addr4> <CRC> <STOP>
```

For each of the 4 possible votes 16 bits are transmitted from the CU – 12 bits for the vote and 4 bits for the vote.

Addresses and votes:

Address 1 = 16*Presence MSB addr1 + Presence LSB addr1[Bit3-Bit0]
Vote1 = Presence LSB addr1[Bit7-Bit4]

Address 2 = 16*MSB addr2 + Presence LSB addr2[Bit3-Bit0]
Vote 2 = Presence LSB addr2[Bit7-Bit4]

Address 3 = 16*MSB addr3 + Presence LSB addr3[Bit3-Bit0]
Vote 3 = Presence LSB addr3[Bit7-Bit4]

Address 4 = 16*MSB addr4 + Presence LSB addr4[Bit3-Bit0]
Vote 4 = Presence LSB addr4[bit7-Bit4]

Votes are defined as follows:

Yes:	Vote=1
Abstain:	Vote=2
No:	Vote=3

The votes of a delegate is only valid, if the address is not 0 and the Vote is not 0:

Example:
Imagine, that the CU has received a Yes-vote from address 3 and a No-vote from address 20.
The CU 'packs' the votes of both units into the same message.

```
<START> 'c' <ID> <15> <173> <69> <8> <0> <19> <1> <52> <0> <0> <0> <18> <CRC> <STOP>
```

For Address 1 we have:

Address 1 = 16* <Vote MSB addr1> + <Vote LSB addr1 [Bit3-Bit0]>
= 16 * 0 + 3 = 3
Vote 1 = <Vote LSB addr1 [Bit7-Bit4]>
= 1 ***(Yes-vote from address 3)***

For Address 2 we have:

Address 2 = 16* <Vote MSB addr2> + <Vote LSB addr2 [Bit3-Bit0]>
= 16 * 0 + 3 = 3
Vote 2 = <Vote LSB addr2 [Bit7-Bit4]>
= 3 ***(No-vote from address 20)***

For Address 3 and Address 4 there is no information (all is 0).

4.6 Summary of status control messages (CU → External control unit)

Below, all the status control messages that can be sent from the CU to an external control unit are listed.

MAIN_GRP (=1):

Command Item	**value**	**Comment**
MAIN_LOST_UNIT	4	A unit has become passive (lost) in the DCS6000 system
MAIN_FOUND_UNIT	26	A unit has become active (found) in the DCS6000 system

EXTERNAL_CONTROL_GRP (=27):

Command Item	**value**	**Comment**
EXTERNAL_UNIT_ADDRESS	2	Registration reply to an external control unit.

EXTERNAL_HEART_BEAT_REQUEST	3	Request to external control units to confirm RS232 communication

MICROPHONE_STATUS_GRP (=23):

Command Item	**value**	**Comment**
MICROPHONE_STATUS_DELEGATE_OFF_ACTIVE	1	Delegate Off is active
MICROPHONE_STATUS_DELEGATE_OFF_INACTIVE	2	Delegate Off is no longer active
MICROPHONE_STATUS_DELEGATE_MUTE_ACTIVE	3	All speaking delegates are muted
MICROPHONE_STATUS_DELEGATE_MUTE_INACTIVE	4	Speaking delegates are no longer muted
MICROPHONE_STATUS_MICROPHONE_IN_REQUEST	7	A delegate is in request
MICROPHONE_STATUS_MICROPHONE_IN_SPEAK	8	A delegate is speaking
MICROPHONE_STATUS_MICROPHONE_ON	9	A delegate microphone is turned on
MICROPHONE_STATUS_MICROPHONE_OFF	10	A delegate microphone is turned off
MICROPHONE_STATUS_REQUEST_ON	11	A delegate is inserted in the request list
MICROPHONE_STATUS_REQUEST_OFF	12	A delegate is removed from the request list
MICROPHONE_STATUS_MAX_REQUESTS	14	Size of request list
MICROPHONE_STATUS_MAX_SPEAKERS	15	Number of delegates allowed being open simultaneously.
MICROPHONE_STATUS_SYSTEM_OPERATION_MODE	16	Operation Mode
MICROPHONE_STATUS_MICROPHONE_UNIT_STATUS	18	Status of a single microphone unit
MICROPHONE_STATUS_UPDATE_START	19	Start of a status stream
MICROPHONE_STATUS_UPDATE_STOP	20	Status stream is ended
MICROPHONE_STATUS_MICROPHONE_ACTIVITY_STATUS	22	Status of a single microphone unit

EXTERNAL_AUDIO_STATUS_MU (=29):

Command Item	**value**	**Comment**
AUDIO_STATUS_MU_SPEAKER_VOLUME	2	Volume of delegate loudspeakers
AUDIO_STATUS_MU_SPEAKER_ON	3	Delegate loudspeakers turned on
AUDIO_STATUS_MU_SPEAKER_OFF	4	Delegate loudspeakers turned off
AUDIO_STATUS_MU_LINEOUT_VOLUME	5	Volume of LineOut
AUDIO_STATUS_MU_MIC_TO_SPEAKER	6	Audio level from speaking delegates to delegate loudspeakers
AUDIO_STATUS_MU_MIC_TO_LINEOUT	7	Audio level from speaking

		delegates to LineOut
AUDIO_STATUS_MU_LINEIN_TO_SPEAKER	8	Audio level from LineIn to delegate loudspeakers
AUDIO_STATUS_MU_LINEIN_TO_LINEOUT	9	Audio level from LineIn to LineOut
AUDIO_STATUS_MU_LINE_IN_LEVEL	14	LineIn level.
AUDIO_STATUS_MU_STATUS_START	20	Start of Audio status stream
AUDIO_STATUS_MU_STATUS_STOP	21	End of Audio status stream

VOTING_STATUS_GRP (=53):

Command Item	**value**	**Comment**
VOTING_STATUS_TYPE_OF_VOTING	1	3-Button voting or 5-Button voting
VOTING_STATUS_SECRET_VOTING	3	Open or Secret voting
VOTING_STATUS_ATTENDANCE_CHECK_STARTED	11	An attendance check is started
VOTING_STATUS_ATTENDANCE_CHECK_STOPPED	12	An attendance check is stopped
VOTING_STATUS_ATTENDANCE_CHECK_CANCELLED	13	An attendance check is cancelled
VOTING_STATUS_INTERIM_ATTENDANCE_RESULT	14	Interim attendance check results
VOTING_STATUS_ATTENDANCE_RESULT	15	Final attendance check
VOTING_STATUS_VOTING_OPENED	16	A voting session is started
VOTING_STATUS_VOTING_CLOSED	17	A voting session is ended
VOTING_STATUS_VOTING_CANCELLED	19	A voting session is cancelled
VOTING_STATUS_INTERIM_VOTING_RESULTS	21	Interim voting resuls
VOTING_STATUS_VOTING_RESULTS	22	Final voting results

UNIT_ATTENDANCE_STATUS_GRP (=58)
UNIT_VOTE_STATUS_GRP (=69)

5 Controlling Microphones

The purpose of this section is to give a short summary of how the methods described in the rest of the manual can be used to control the system.

5.1 CRC Calculation

5.1.1 CU Reset message

When the CU is powered up, the very first control message to send to the external control unit is a ‘CU reset’ message.

It has the format:

<START> ‘r’ <ID> <CRC> <STOP>

The CRC-checksum is calculated from the bytes ‘r’ <ID>
With ID=0, the CRC becomes 136 and the complete message gets the following contents:
[252] [114] [0] [136] [253]

5.1.2 Entering binary microphone control mode

The binary microphone control mode is entered by the ‘Change Mode’ control message. It has the following format:

<START> ‘m’ <ID> ‘c’ ‘m’ <CRC> <STOP>

With ID=0, the CRC becomes 101 and the complete message gets the following contents:
[252] [109] [0] [99] [109] [101] [253]

See also 6.1.1.

5.2 Registering with the CU

Basically, there are two different ways to get the communication between the CU and an external control unit up and running. These scenarios are described below.

5.2.1 Power up of the CU after connecting

When the connection to the CU is done prior to putting power on the CU, the external control unit will receive start up information from the CU at power up, the 'CU reset' message. This is the initial message indicating, that the CU is powered up.

In order for the external control unit to be able to control the microphone functionality of the CU, it is necessary to make the CU enter the binary microphone control mode. Furthermore, the external control unit must perform a registration in the CU.

The following sequence shows, how the start up and registration takes place:

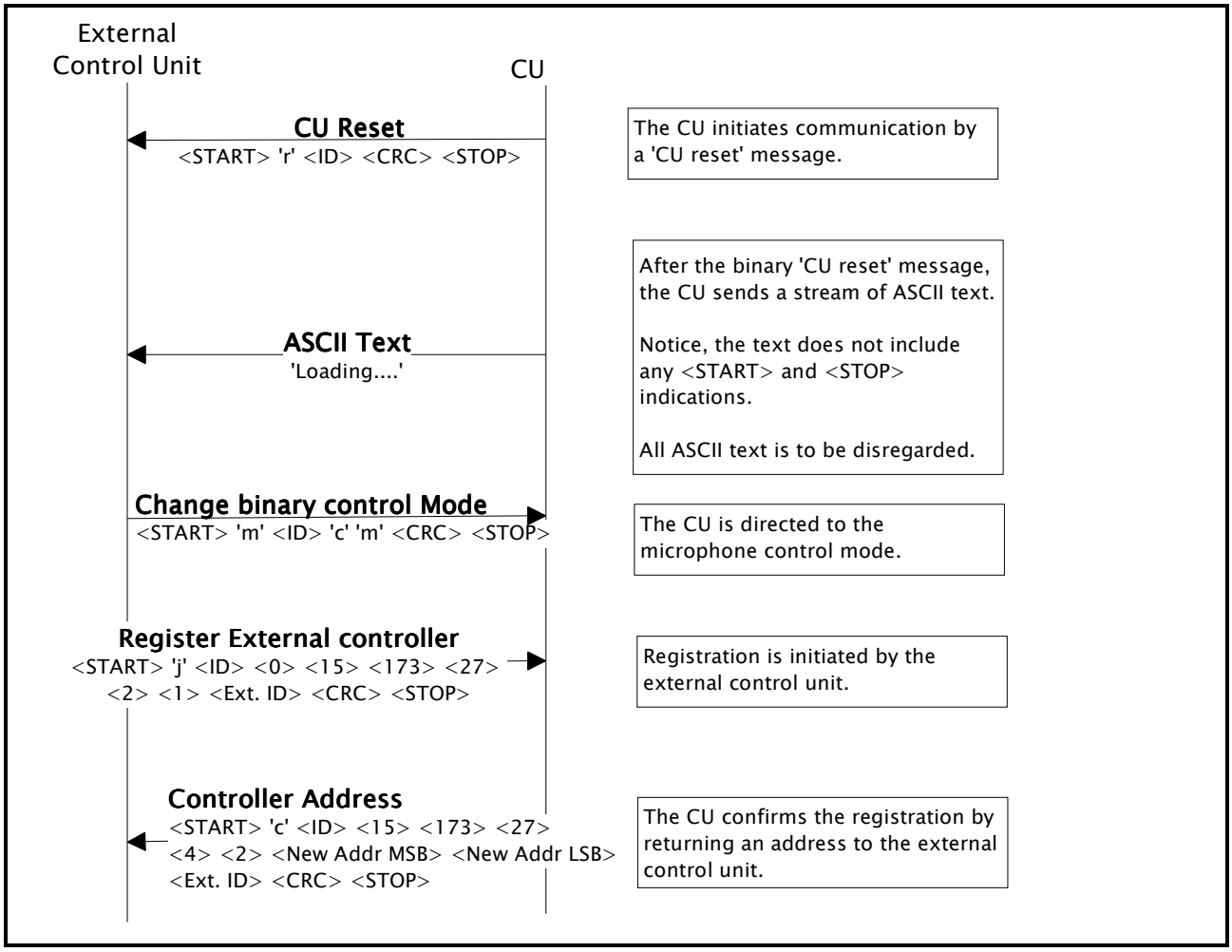


Figure 1 - *Start up and registration*

After the ‘CU reset’ message, the CU transmits an ASCII text. This text is not wrapped in <START> and <STOP> delimiters, so it should simply be dismissed.

Inside the CU, an initialization phase takes place after sending of the ‘CU reset’ message. The external control unit may respond to immediately to the ‘CU reset’ message by putting the CU in binary microphone control mode, and by initiating registration in the CU, but the CU is unable to reply to the registration for approximately 3 seconds after the ‘CU reset’ message.

5.2.2 Power up of the CU before connecting

If the external control unit connects to the CU after power up of the CU, the setup of binary microphone control mode and registration of external controller may take place immediately.

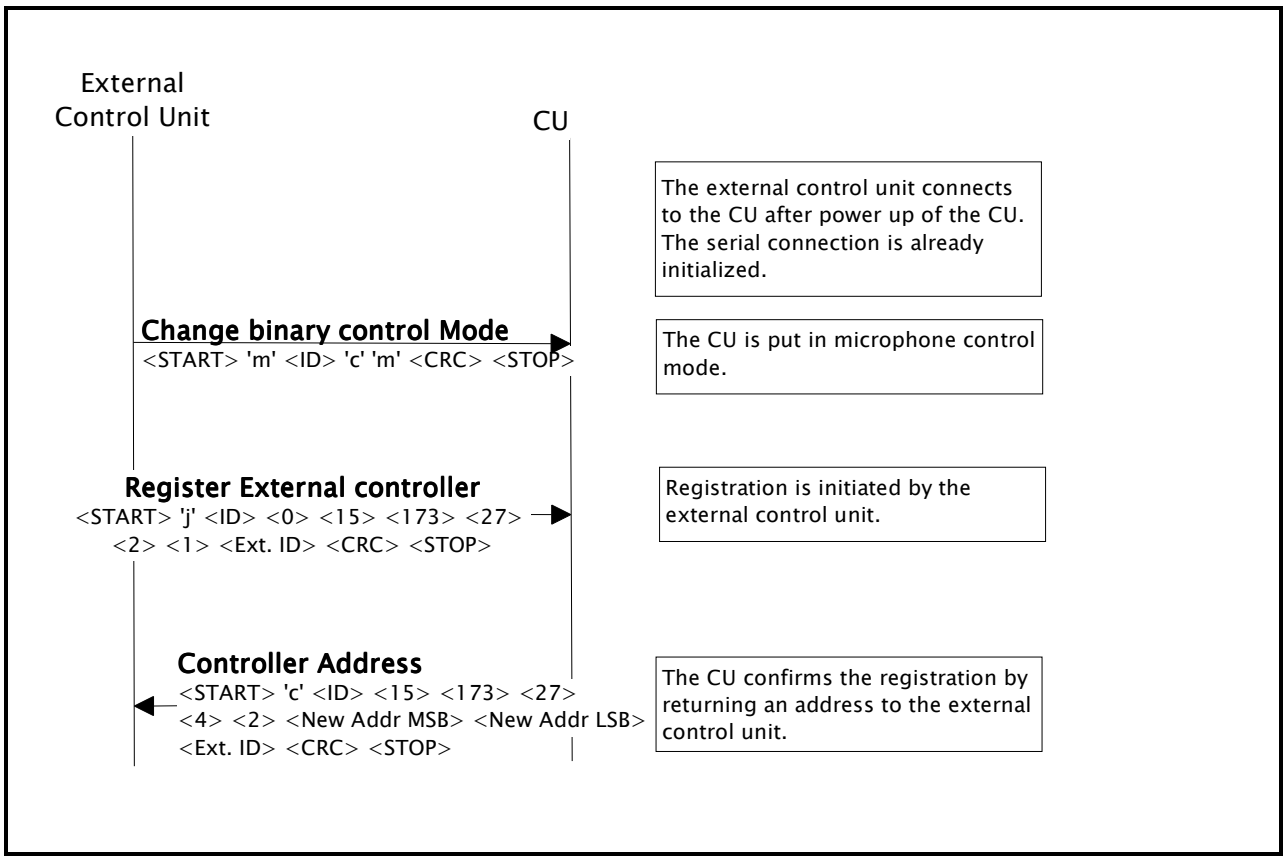


Figure 2 - *Connecting to a CU after CU power up.*

5.3 The Heart Beat process

After the external controller has been registered in the CU, it becomes part of the **heart beat process**. The heart beat process consists of a pair of control messages, a reply from the CU and a response from the external control unit. Every 5 seconds, the CU sends a Heart Beat Request to the external control unit, and by responding by a Heart Beat Reply, the external control unit indicates, that it is an active controller.

If the CU does not receive reply to 3 consecutive Heart Beat Requests, it assumes, that the control unit has lost control of the CU.

The following sequence shows the Heart Beat communication:

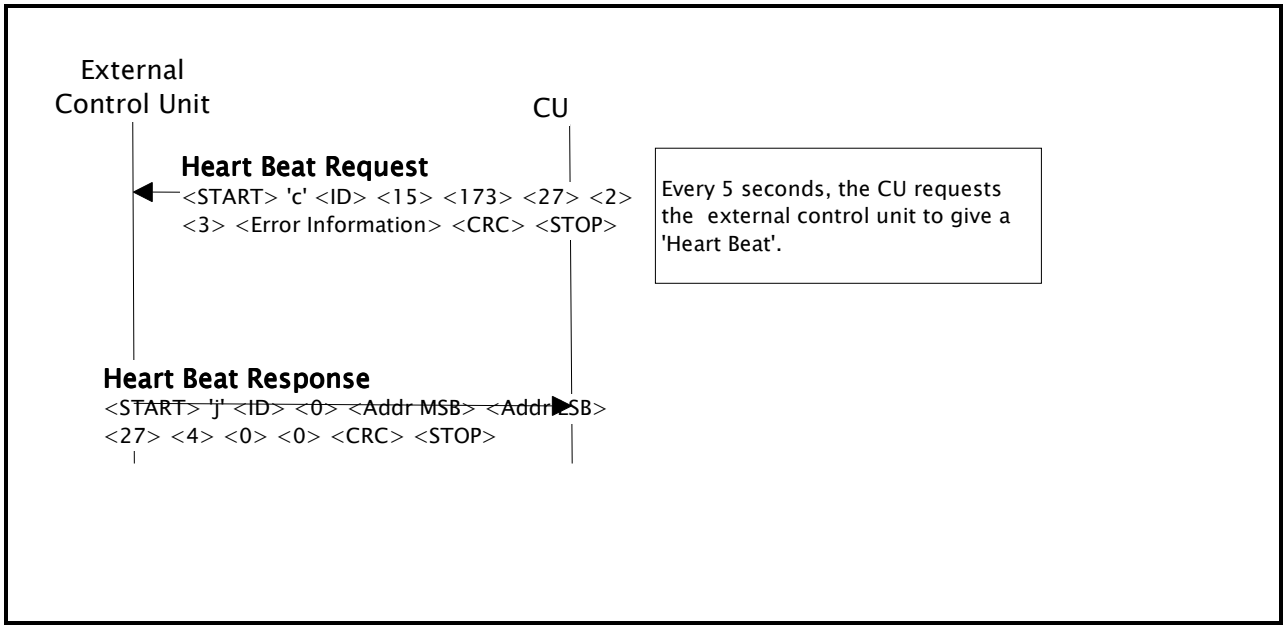


Figure 3 - *Heart Beats*

5.4 Retrieving the microphone system status

After completing registration, the system status must be aligned between the external control unit and the CU. The status of the CU must be transferred to the external control unit.

The complete status of the microphone system can be retrieved from the CU in two sets of information:

- Microphone control system status
- Microphone audio system status

The following sequence illustrates retrieval of the microphone control system status.

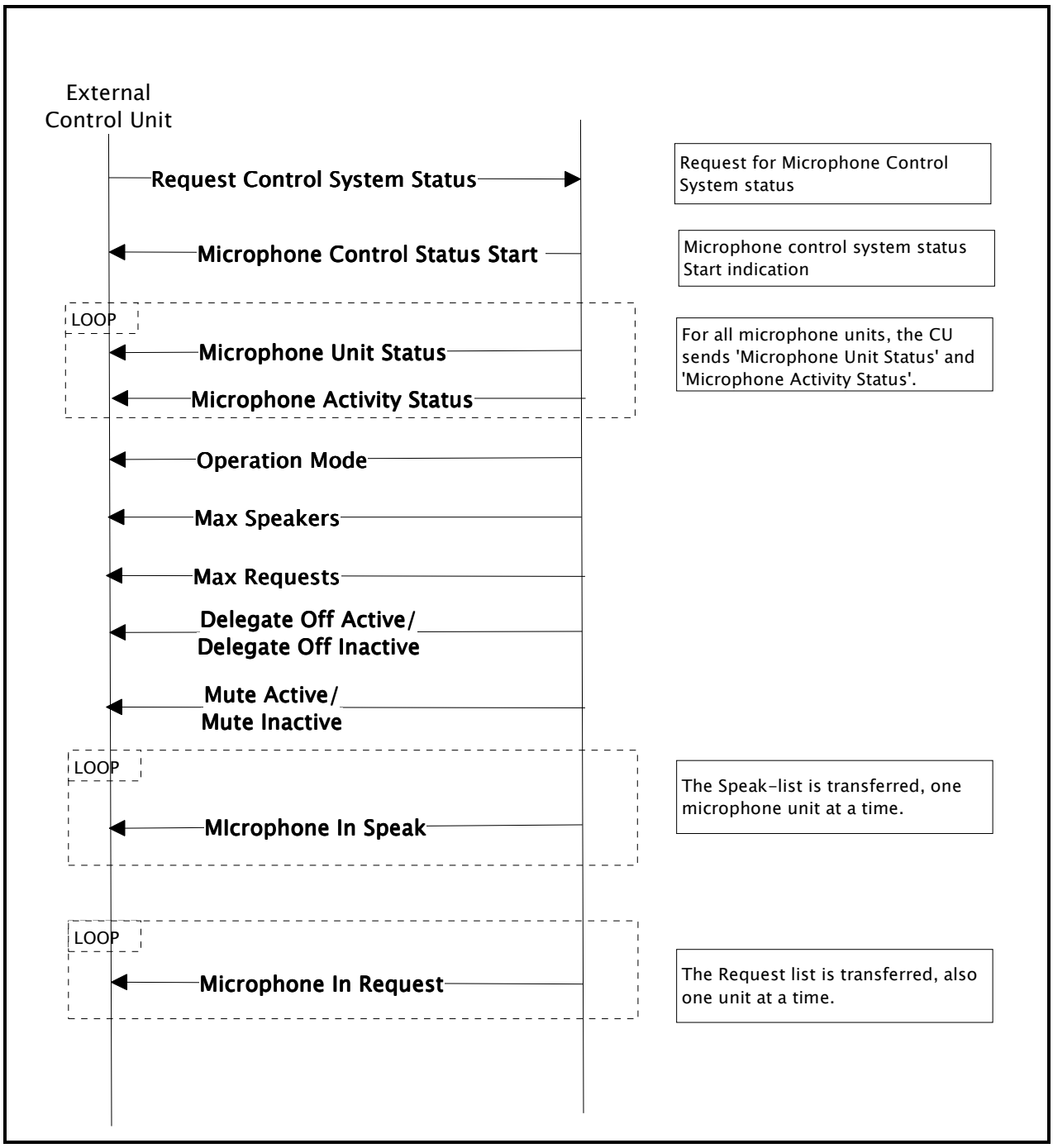


Figure 4 - *Retrieval of Microphone Control System Status*

The following sequence shows retrieval of Microphone Audio System status:

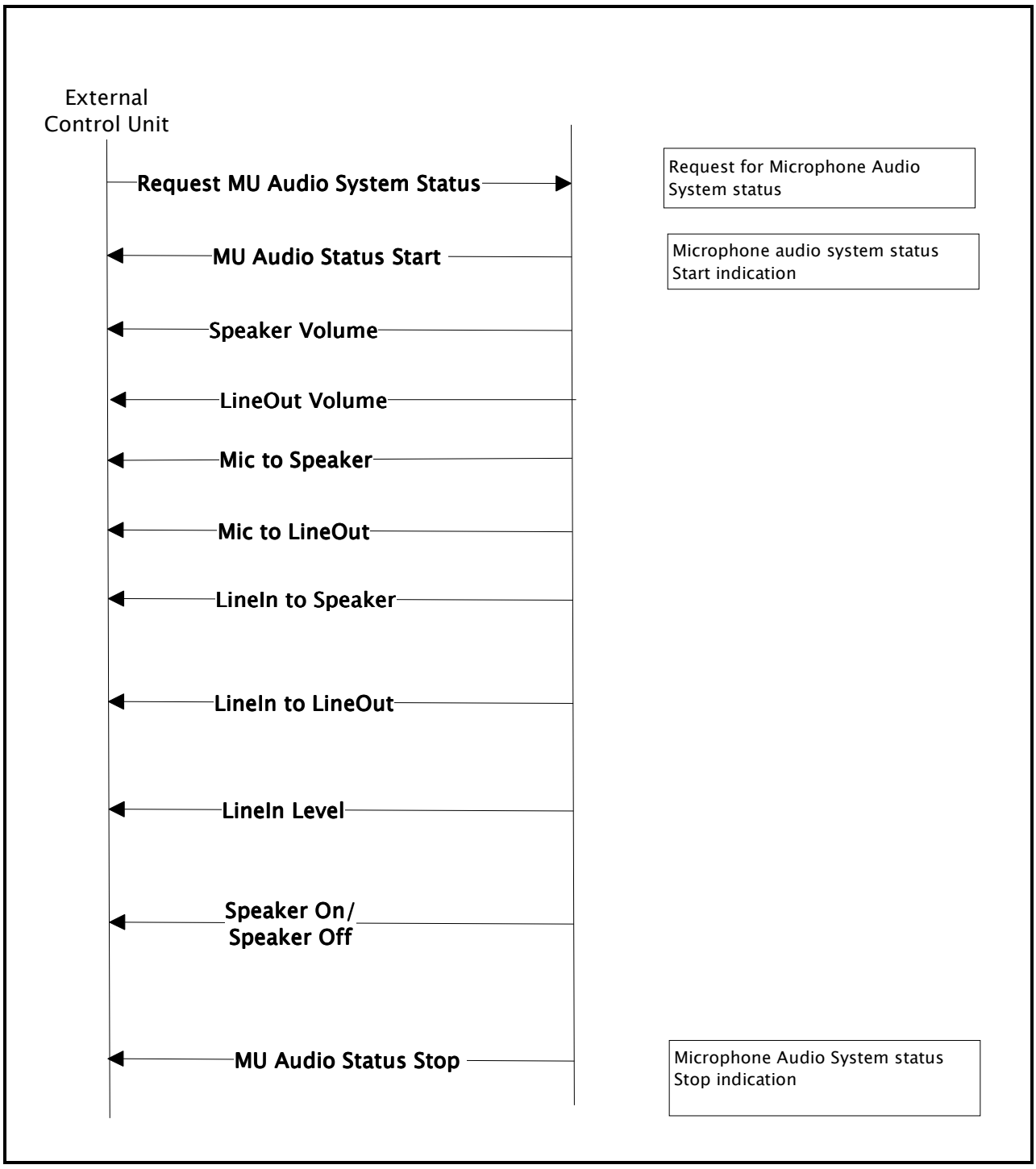


Figure 5 - *Retrieval of Microphone Audio System Status*

6 Additional detailed example

6.1 Example - Registration with the CU

The first example shows how registration with the CU is done from AMX. The AMX equipment is connected to the CU via the RS232 connection. The CU has already been powered up.

Three steps must be passed:

- Step (1) - The CU must be put in Microphone Control Mode
- Step (2) – A registration request must be transmitted from AMX
- Step (3) – The registration reply is received in AMX

6.1.1 Step (1) – Entering Microphone Control Mode

Entering the microphone control mode is done by sending a 'Change Binary Control Mode' message. Below, the contents of the control message for entering the microphone control mode is decided, step-by-step as explained in 3.5.

Step (1.A) – Decide the Message Type and contents

From chapter 3.4.2 the Message Type is ASCII character 'm', which corresponds to the binary value <109> or hexadecimal value [0x6D].

The contents are also found in chapter 3.4.2 to be 'c' 'm'.

Step (1.B) – Decide the ID of the message

The ID of a control message indicates, which number the message has in a sequence of messages sent from the AMX to the CU.
For this example, the ID is given the value <0>.

Now, the unfinished control message looks like this:

'm' <0> 'c' 'm'

Step (1.C) – CRC calculation

In order to prevent transmission errors, a CRC-check sum is added to the control message.

CRC calculation is done byte for byte starting with CRC-value=0 and the first byte ('m'). These are exclusive or'd and used as index in the lookup table.

Going byte by byte gives the following table of results:

Byte	Last CRC-value	Table lookup index	New CRC-value
'm' = <109> = [6D]	<0> = [0]	[6D]^[0] = [6D] = <109>	<4>
<0> = [0]	<4> = [4]	[0]^[4] = [4] = <4>	<28>
'c'= <99> = [63]	<28> = [1C]	[63]^[1C] = [7F] = <127>	<122>
'm' = <109> = [6D]	<122> = [7A]	[6D]^[7A] = [17] = <23>	'e' = <101>

Resulting CRC-value is <109>.

Now, the unfinished control message looks like this:

'm' <0> 'c' 'm' 'e'

Step (1.D) – Check for encoding of escape characters

In order to avoid problems with the special values (252, 253 and 254) it is checked, if any of these values are part of the message to send. For this example, that is not the case.

No modification is required.

Step (1.E) – Adding start and stop delimiters to the control message

The final step is to include the start and stop delimiters:

<252> 'm' <0> 'c' 'm' 'e' <253>

or in decimal:

<252> <109> <0> <99> <109> <101> <253>

Hexadecimal:

[FC] [6D] [00] [63] [6D] [65] [FD]

6.1.2 Step(2) – Requesting registration in the CU

After entering microphone control mode, it is time to send a registration request to the CU. The control message required to do registration is EXTERNAL_NEW_UNIT in the EXTERNAL_CONTROL_GRP.

Again the five steps of above must be completed to find the full control message to send:

Step	Action	Control Message
1	**Deciding MessageType and contents.** Message Type: 'j'. Contents: <0> <15> <173> <27> <1> <12> <External Identity> For this example the External Identity is set to 60.	 'j' + <0> <15> <173> <27> <1> <2> <60>
2	Deciding the ID of the message. The ID before was 0, so now 1 is used.	'j' <1> <0> <15> <173> <27> <1> <2> <60>
3	CRC calculation The CRC of the message becomes 184.	'j' <1> <0> <15> <173> <27> <1> <2> <60> <184>
4	Check for Escape characters No use of values 252, 253 or 254.	'j' <1> <0> <15> <173> <27> <1> <2> <60> <184>
5	Addition of start and stop	<252> 'j' <1> <0> <15> <173> <27> <1> <2> <60> <184> <253>

The resulting control message becomes:
<252> 'j' <1> <0> <15> <173> <27> <1> <2> <60> <184> <253>
or
[FC] [6A] [01] [00] [0F] [AD] [1B] [01] [02] [3C] [B8] [FD]

6.1.3 Step(3) – Registration reply from the CU

The Registration Reply is received from the CU (EXTERNAL_UNIT_ADDRESS in EXTERNAL_CONTROL_GRP). The following reply is received:

[FC] [63] [01] [0F] [AD] [1B] [04] [02] [0F] [3C] [3C] [D1] [253]

<252> ‘c’ <1> <15> <173> <27> <4> <2> <15> <60> <60> <209> <253>

When receiving a control message from the CU, the external control unit must go through the 5 steps of control message building in opposite order:

1.Find and remove <start> and <stop> indications
‘c’ <1> <15> <173> <27> <4> <2> <15> <60> <60> <209>

2.Strip Escape characters.
‘c’ <1> <15> <173> <27> <4> <2> <15> <60> <60> <209>

3.Identify the CRC-check sum and verify the correctness.
‘c’ <1> <15> <173> <27> <4> <2> <15> <60> <60>

4.Identify and remove the ID of the message.
‘c’ + <15> <173> <27> <4> <2> <15> <60> <60>

5.Identify the message type in order to understand the contents of the control message.
‘c’ means control message from the CU. It has the following format:

<START> 'c' <ID> <MSB addr> <LSB addr> <Message Group> <len> <Data 1>..<Data N> <CRC> <STOP>

So, the contents can now be identified:

MSB addr = 15
LSB addr = 173
Message Group = 27
len = 4
Data = <2> <15> <60> <60>

Further steps are required to fully retrieve the information of the control message.

6.Receiver address checking
Besides the above 5 steps, the external control unit must verify that the control message needs to be treated. This is done by checking the receiver address.

Receiver Address = MSB addr * 256 + LSB addr = 4013

4013 is the group address of external control units, and that naturally needs to be handled.

7.Determining the message group and the contents of the control message:
The message group is 27, and the command item is 2 (EXTERNAL_UNIT_ADDRESS).

The contents of the control message has the following format:

```
<START> 'c' <ID> <MSB addr> <LSB addr> <27> <4> <2> <Addr MSB> <Addr LSB> <External Identity> <CRC>
<STOP>
```

where the new address applying to the control unit is extracted as part of the data:

New External Unit Addr = Addr MSB * 256 + Addr LSB = 3900

and

External Identity = 60

So, in the future communication between the external control unit and the CU, the external control unit must use the address 3900.

6.2 Example 2 – Turning on the microphone of a delegate.

Assume, that a control unit has connected to a CU, entered microphone control mode and registered in the CU. Furthermore, the microphone status has been retrieved from the CU.

Now, a chairman wants to turn on the microphone of a delegate. Assume this is the microphone with the address number 10.

To turn the microphone, the external control unit must send the control message MICROPHONE_CONTROL_MICROPHONE_ON (MICROPHONE_CONTROL_GRP).

Message format:

```
<START> ‘j’ <ID> <0> <MSB addr> <LSB Addr> <18> <14> <Microphone Addr MSB> <Microphone Addr LSB> <CRC>
<STOP>
```

With address=3900 and ID=45, we get the following:

‘j’ <45> <0> <15> <60> <18> <14> <0> <10>

CRC-calculation gives 140, and with <Start> and <Stop> added, the control message to send becomes:

<252> ‘j’ <45> <0> <15> <60> <18> <14> <0> <10> <140> <253>

or

[FC] [6A] [2D] [00] [0F] [3C] [12] [0E] [00] [0A] [8C] [fD]